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"A SIMPLE DYNAMOMETER"

In reply to the above criticism by Professor Barnes the undersigned would say that it was not his intention that anyone should interpret the method described as a way to estimate the total imbibition force in all directions: but it is hardly possible, of course, to make an experiment absolutely safe against misunderstanding. The apparatus described by MacDougal* is about the only one which will adequately represent this force. In this method enough seeds are used so that the total thrust of expansion is delivered within the range of the manometer. With proper precautions however the apparatus described as "a simple dynamometer" may be made use of for a comparative study of the force of imbibition in one—the vertical direction. The precaution is a simple one, namely that the scale be not overloaded, or in other words that the amount of material used be coördinated with strength of the spring. In common with other apparatus of this type the critical point at which overloading begins can only be determined by empirical experimentation.

The same objections as those brought forward by Professor Barnes could also be made to Pfeffer's spring dynamometer† or indeed to the common lever dynamometer if the same precaution is neglected. The apparatus described by Detmer‡ is in effect much the same, and the results obtained by it could also be rendered of small import if a two gram instead of a two hundred gram weight were used on the platform.

It should indeed have been stated that it was a "2 lb." letter scale which was used. The weaker scales might serve for indicating force exerted by the downward growth of certain roots; ones in other words which were adapted to the strength of the spring within the scale.—HERBERT M. RICHARDS, *Barnard College*.

* Journ. N. Y. Bot. Gard. 2: 39. Mr. 1901.

† Druck und Arbeitsleistung durch wachsende Pflanzen p. 18 et seq. Leipzig. 1893

‡ Practical Plant Physiology (translation), 142.